Modification of an ETA-6497-1 Wristwatch Movement

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MIND option, Industrialization Methods, Promotion 2024-2025
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Abstract. The objective of this project is to modify the design of an ETA-6497-1 wristwatch movement to embellish it, and to then industrialize the construction of this modification. This paper will cover the design and conception of the movement's modification, as well as the thinking process behind the method of construction and materials chosen.

Keywords: ETA-6497-1; Watch; Wristwatch; Watchmaking; Watch movement.

INTRODUCTION

The ETA-6497-1 is a basic manual wind watch movement that is very popular among watchmakers for its ease of access, as well as its reliability and robustness. The purpose of this project is to modify the movement to embellish it.

The first step in this project is to create a CAD model of the movement, to then add in new components to redesign the display.

The second step is to change the position of the main spring to make it visible on the display side of the movement.

STATE-OF-THE-ART

In the watchmaking industry, the manufacturing methods, to this day, are still mostly manual. Indeed, the design of watches used to be made entirely with a traditional lathe, and the finishing was then done manually (polishing, engraving, chamfering or bevelling, guillochage…).

Since the 20th century, the watchmaking industry has veered towards mass production, therefore manufacturing techniques progressively became more automated until the 70s.

At that time, the quartz movement started taking over. Cheaper and more robust compared to expensive and inaccurate traditional wristwatches, watchmakers had to adapt to its rapid expansion.

The change was made in the 1990s under the impulsion of diverse personalities such as Jean-Claude Biver. His philosophy was to create a new complex mechanism combining new technologies and traditional manufacturing methods.

METHODS

Development:

The development method followed is inspired by the practices of watch manufacturers. The first major stage of the project focuses on the design and reverse engineering of the ETA-6497-1 movement, as well as the creation of a new caliber. The chosen design is a direct result of the concept defining the project. The objective is to transform the appearance of an existing movement and introduce a new display of hours and minutes.

The next phase involves the 3D design of all the components, as well as the choice of technical solutions. Once the design has been validated, the industrialization of the parts begins: this includes the selection of materials, the definition of manufacturing processes, and preparation for machining and assembly. This phase is done along with the design of the necessary tools and the use of CAM (Computer Aided Manufacturing).

Finally, the project concludes with the manual finishing of the components and the final assembly of the movement, guaranteeing both watchmaking quality and an exceptional aesthetic result.

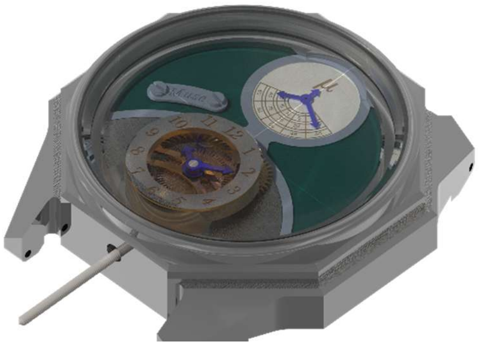
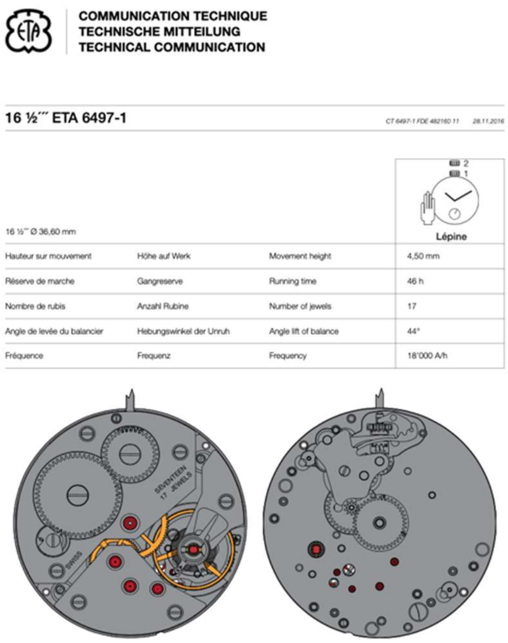


Fig. 1: Watch CAD design

Choice of caliber:

As with many timepieces from renowned watchmaking houses, we have chosen to use a reference caliber as the basis for the development of our watch. The selected movement is the ETA-6497-1, celebrated for its robustness and forgiving dimensions, making it particularly well-suited for large-diameter watches. This caliber was notably featured in select Panerai collections during the early 2000s. Its reliability and generous size present a dual advantage: they streamline the design process for new components while simplifying their production.


COMMUNICATION TECHNIQUE
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16 ½''' ETA 6497-1 CT 6497-1 FDE 482160 11 28.11.2016

16 ½''' Ø 36,60 mm

			Lépine
Hauteur sur mouvement	Höhe auf Werk	Movement height	4,50 mm
Réserve de marche	Gangreserve	Running time	46 h
Nombre de rubis	Anzahl Rubine	Number of jewels	17
Angle de levée du balancier	Hebungswinkel der Unruh	Angle lift of balance	44°
Fréquence	Frequenz	Frequency	18'000 A/h

Fig. 2: ETA-6497-1 caliber

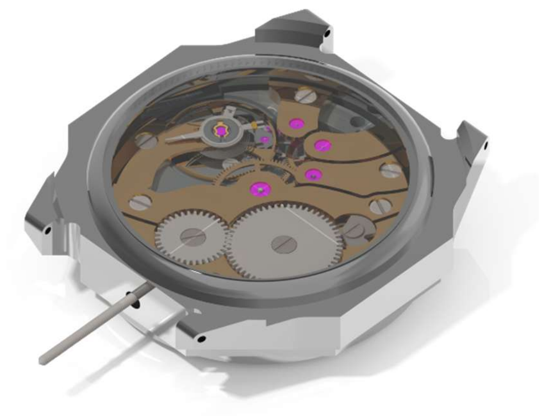

Fig. 3: CAD design of the modified bridges

To shift the hours and minutes display on the dial, we opted to add an additional plate. This solution minimizes alterations to the base movement, a method commonly employed by renowned watchmaking solution providers such as Chronode and Vaucher.

We designed an additional motion works gear train on the module plate, which draws energy and transmits the necessary information for time display from the main movement through a double cannon pinion, as shown in the kinematic diagram [3].

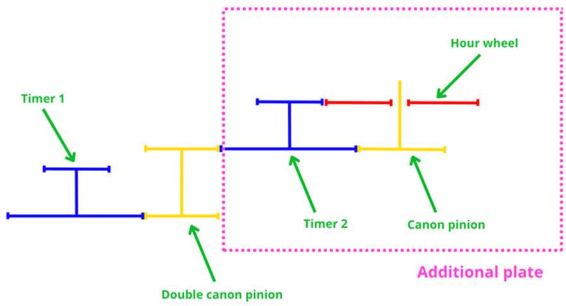

Fig. 4: solution kinematic diagram

Choice of materials:

The selection of materials in our project is driven primarily by considerations of aesthetics and robustness. The chosen steels must be resistant to oxidation, capable of being machined to small dimensions with micro-level tolerances, and suitable for manual finishing, which requires a relatively low hardness (e.g., around **250-300 HV** on the Vickers scale).

Additionally, financial constraints play a significant role, as the objective is to produce a visually appealing watch with a high level of finish while working within a limited budget. Based on these criteria, we have selected three primary materials:

- **Brass (CuZn39Pb2)** for the dial and bridges, offering excellent machinability and aesthetic flexibility.
- **Aluminum (LA 7075)** for certain dial elements, valued for its light weight and structural strength.
- **316L stainless steel (EN X2CrNiMo)** for the case and external components, chosen for its corrosion resistance and durability.

This combination ensures a balance between performance, aesthetics, and cost-efficiency.

Choice of manufacturing methods:

The selection of manufacturing methods is driven by the type of parts and the required dimensional tolerances. We used a 4-axis lathe to machine the hour circle and dial circle, a 3-axis CNC to manufacture the bridges and modifying the plate, and a wire EDM machine for finishing the hour circle, as this process enables the creation of very small radius with high precision.

Supply parts, such as pins and rings, are manufactured through bar turning, a method that offers micro-level precision and is ideal for machining small rotational components.

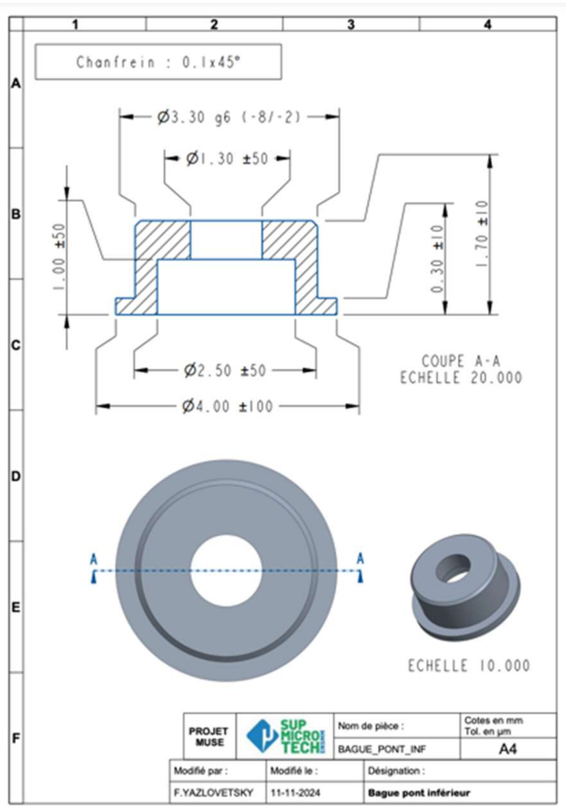

Fig. 5: ring turning piece

For finishing, we prioritize industrial processes to streamline subsequent manual operations. For instance, Geneva stripes are created using a rough surfacing cutter, while corners are shaped with a chamfering cutter. The final finishing touches are applied manually using a polishing lathe, grinding wheels, files, and burrs.

Fig. 6: Geneva stripes

In summary, rotational parts are primarily machined via turning, whereas other components are produced through milling.

Fig. 7: manual beveling

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